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Top U.S. and Mexican Fishery Officials Meet in La Jolla to Discuss Cooperative Fisheries Research

With the objective of establishing cooperative fisheries research on projects of mutual interest to Mexico and the United States, a Mexican delegation headed by Pedro Ojeda Paullada, Mexican Secretary of Fisheries, met with the U.S. delegation, headed by Dr. William E. Evans, Assistant Administrator for Fisheries, for the first formal MEXUS-Pacifico meeting, which was held at the Southwest Fisheries Center on August 10 and 11.

The idea of conducting cooperative fisheries research on projects of mutual interest on the western coast of the states of Baja California, Mexico, and the Pacific coast of the United States had its beginnings in the Pacific Coast Memorandum of Agreement in the fall of 1986 when the Mexican Instituto Nacional de la Pesca and the Southwest Fisheries Center agreed that such a program was in the best interests of both countries. Further groundwork was laid at the preparatory meeting in La Paz, Baja California Sur, where scientific committees were formed on fisheries monitoring and analysis of fisheries resources.

During the meeting, the scientists from the U.S. and Mexico who constitute the newly established MEXUS-Pacifico subcommittees on Analysis of Fisheries Resources and on Fisheries Monitoring outlined specific action for exchange of data and the standardization of methodologies and research to be undertaken by both countries on such fish species as sardine, jack mackerel, anchovy, and Pacific mackerel in 1987-1988 (see article by Richard Methot in this issue).

Principals in U.S. and Mexican delegation confer at MEXUS-Pacifico meeting.

Also participating in the meeting were Howard O. Ness, Fisheries Attache for Latin America, Ambassador Fernando Castro y Castro, Undersecretary for Fisheries Infrastructure, and Dr. Alfredo Laguarda, Director of the Instituto Nacional de la Pesca, as well as many others.

Although the present focus is on only four species, the meeting provides a framework for possible future collaborative work on marine mammals, on recreational and demersal species, and on billfishes and swordfish.

Participants of the MEXUS-Pacifico meeting (from left to right): José Manuel Grande, INP; Jesús Pineda, Student at SIO; Myrna Wong Rios, INP; Alec MacCall, NMFS; Richard Methot, NMFS; Miguel Angel Cisneros, INP; Patricia Wolf, CDF&G; Dennis Weidner, NMFS; Silvia Silva Sanchez, INP; E. Charles Fullerton, NMFS; Francisco Sosa y Avila, Secretaria de la Pesca (SEPESCA); Damaso Luna Corona, SEPESCA; Maria Teresa Bandala (SEPESCA); Alfonso Lopez Cruz (SEPESCA); Juan Manuel Cervantes (SEPESCA); Ambassador Fernando Castro y Castro, Undersecretary for Fisheries; William Evans, NMFS; Richard Klingbeil, CDF&G; Pedro Ojeda Paullada, Minister of Fisheries; Robert Fletcher, CDF&G; Izadore Barrett, NMFS; Paul Smith, NMFS; Guido Belsaso, President, Ocean Garden Products, Inc.; Howard Ness, U.S. Regional Fisheries Attache; Nancy Lo, NMFS; John Hunter, NMFS; Alfredo Laguarda Figueras, INP; Walter Ocampo, Mexico Department of Fisheries; Alfredo Cota Villavicencio, INP.

COASTAL FISHERIES RESOURCES DIVISION
La Jolla, California

COMMERCIAL AND RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT

MEXUS-Pacifico Subcommittee Hold Meetings

Preceding the first formal MEXUS-Pacifico meeting (see first article in this issue) from August 10 to 11, 1987, two MEXUS-Pacifico subcommittees, charged with development of joint work programs for 1987-88, met on August 6 and 7. Objectives for the two subcommittees had been established at the MEXUS-Pacifico preparatory meeting held on May 18-20, 1987, in La Paz, Baja California Sur. The Subcommittee for Analysis of Fisheries Resources has the responsibility for development of research and survey plans for anchovy, sardine and mackerel, and is co-chaired by Fishery Biologist Dr. Alec MacCall of the SWFC, and Dr. Silvia Silva Sanchez, Instituto Nacional de la Pesca (INP). The Subcommittee for Monitoring of Fisheries was charged with facilitating the exchange of quantitative fishery information, and is co-chaired by Fishery Biologist Dr. Richard Methot of the SWFC, and Miguel Angel Cisneros, INP. The subcommittee meetings included other participants from the SWFC, INP, and the California Department of Fish and Game.

The Subcommittee for Analysis of Fisheries Resources established a plan for joint resource surveys and for methodology workshops. Two cooperative cruises are planned for 1988. During February and March, the research vessel *Alejandro de Humboldt* will be used to measure the abundance of the central subpopulation of anchovy by application of the egg production method. During May, the *Humboldt* and a vessel chartered by CDF&G will measure the distribution and abundance of sardine eggs off California and northern Baja California. In preparation for these cruises, two workshops on the egg production method will be held in late 1987, one in Mazatlan and one in La Jolla.

The Subcommittee for Monitoring of Fisheries established a plan for annual exchange of fisheries data in support of the analytical needs of the Subcommittee for Analysis of Fisheries Resources. The primary focus is on the harvest and age composition data necessary for application of the stock synthesis model to the anchovy stock. The subcommittee also scheduled a workshop on age determination methods to be held in Long Beach, California, during the spring of 1988. In addition, the subcommittee plans to exchange reports that document sampling methods used in monitoring the respective fisheries. (R. Methot, FTS 893-7117 and A. MacCall, FTS 893-7116)

PacFIN Research Data Base Report Issued

Cynthia Thomson, Industry Economist, co-authored with Charles Korson, Southwest Region, "A Report on the PacFIN Research Data Base for 1985" (SWFC Administrative Report LJ-87-21). The Pacific Fisheries Information Network (PacFIN) Research Data Base describes landings and characteristics of commercial fishing vessels on the Pacific Coast. Data files similar in format to those in the 1985 Research Data Base are also available for 1981-1984. In 1985, for the first time, joint venture catches (in addition to the usual data on landings in California, Oregon and Washington) have been included in the data base.

The report briefly describes the content and design of the data base and summarizes the data in a variety of ways. The tables include frequency distributions for vessel length, for annual landed value, and for principal gears, ports and species. It also describes landings by species and state and the number of vessels engaged in interstate fishing activity.

Thomson and Korson report that 11,000 commercial fishing vessels made landings in California, Oregon or Washington and/or engaged in joint venture fishing activity in 1985. Over 60% of these boats made less than $5,000 in ex-vessel revenue during the year.

Catches of all species totaled 369,327 short tons. Landings in California, Oregon and Washington comprised (respectively) 50%, 13% and 28% of this total, with the joint venture fishery accounting for the remaining 9%.

Eighteen vessels engaged in joint venture activity during the year. Although these vessels represent less than 1% of the entire Pacific Coast fleet, they accounted for a disproportionate amount (almost 10%) of total coastwide catch.

The number of fishing vessels increased by 14% between 1984 and 1985. Most of this increase was concentrated among the "marginal" producers--that is, vessels that are less than 30 feet in length and earn less than $5,000 in ex-vessel revenue.

A large portion of the Pacific Coast fleet consists of salmon trollers. In particular, salmon was the principal species for 60% of all vessels and 44% used troll as their principal gear.

Responsibility for maintenance of the PacFIN Research Data Base is being transferred from the SWFC to the SWR's Chuck Korson. Requests to the three states for the data necessary to generate the 1986 version of the data base have been made. (C. Thomson, FTS 893-7115)

West Coast Fishing Fleet Cost-Earnings Data Base Developed

Industry Economists Dale Squires and Sam Herrick with Statistical Aid Jeff Lee are currently documenting the development of a cost and earnings data base for selected west coast vessels that participate in either the west coast groundfish/shrimp trawl fishery, the west coast swordfish/shark drift gillnet fishery, or the U.S. tropical tuna purse seine fishery. The data base is not being assembled with a specific analysis in mind, but to serve the various needs of investigators conducting economic research on west coast fisheries. The data base comprises vessel level landings and revenue data from the PacFIN Research Data Base, and expenditure data obtained from the National Marine Fisheries Service's vessel financial assistance programs.

The PacFIN Research Data Base currently contains annual fish ticket and vessel registration data (landings, ex-vessel prices, and fishing vessel characteristics) for Washington, Oregon and California vessels covering the years 1981 through 1985. Because of its versatile design, comprehensiveness, continuity, and the level of support provided to users, the PacFIN data base has found utility among researchers investigating and monitoring the fishing operations and gross earnings of various west coast fleets.

Fishing vessel cost data are typically assembled on an ad hoc basis: there is nothing available for assembling and organizing vessel cost data that is comparable in design and structure to the PacFIN Research Data Base. Instead, cost data are typically collected as part of a specific study and therefore subject to the special needs and concerns of the investigator. Because a standard reporting format for cost data is lacking, it is difficult to use these data to conduct consistent analyses (e.g. fleet productivity analyses) which draw on both the PacFIN and various vessel cost data bases.

To overcome the limitations associated with ad hoc fishing vessel cost data, the starting point for the cost and earnings data base was obtained from individual west coast vessels participating in the National Marine Fisheries Service's fishing vessel Capital Construction Fund (CCF). For west coast vessels, cost and earnings data obtained from the CCF were supplemented with corresponding PacFIN data to thoroughly document a particular vessel's economic performance over a given time period.

The economic information for each vessel presently in the data base includes: (a) historical vessel purchase price; (b) total vessel earnings from all sources; (c) depreciation; (d) interest expense; (e) insurance expense; (f) other fixed costs; (g) petroleum costs; (h) wages and benefits; (i) maintenance costs; (j) taxes; (k) other variable costs; (l) landings by

species; (m) earnings by species; and, (n) vessel characteristics.

To date, the data base comprises three fleets: a west coast groundfish/shrimp trawl fleet consisting of 173 vessel-year entries, from observations on 74 individual vessels over the 1981-86 time period; a west coast swordfish/shark gillnet fleet consisting of 39 vessel-year entries, from 12 individual vessels covering the period 1983-86; and, a tropical tuna purse seine fleet having 33 vessel-year entries, from 15 vessels over the period 1983-85. As data become available for additional fleets they will be incorporated into the data base. (S. Herrick, FTS 893-7111)

Bathymetric Data for Dover Sole Analysis Collected

Quantitative measurement of ocean bottom area as a function of bottom depth is necessary for the Coastal Fisheries Resources Division's assessment of Dover sole biomass. During the pilot survey for Dover sole conducted in January-February 1987, data on abundance and reproductive rate as a function of bottom depth were collected. Strong trends were observed, with maximum abundance occurring at about 900 m. Conversion of these depth-specific results to estimates for the sampled population requires weighting by the bottom area at each depth. Bottom area also must be known in order to design an appropriately stratified survey for Dover sole in March 1988.

A step towards development of this data base has been taken by Carlos Vedovato, a student working with Fishery Biologist Richard Methot. National Ocean Survey data files containing the 50, 100, 300, 500, 700, and 900 m depth contours were obtained from Fishery Biologist Paul Smith of the SWFC. Mapping programs on the UCSD VAX computer were modified to incorporate and plot these depth contours. Data for the region between 29° and 50° were selected and transferred from the UCSD VAX computer to an IBM PC-AT via the SWFC Molecular's tape drive. A FORTRAN program written for the AT calculates the area between a specified depth contour and an eastward, onshore reference longitude. Areas between depth contours are then calculated by subtracting the shallower depth's reference area from that of the deeper depth (Table 1). In addition, a subset of the data for the region of interest, 34-39°, was transferred to a LOTUS 1-2-3 spreadsheet. There it is being used for quick plots of station locations relative to the depth contours.

Table 1. Areas between specified depth contours in the area of the Dover sole survey.

Region	Depth range				
	50-100m	100-300	300-500	500-700	700-900
	Area (naut. mi.^{2})				
Santa Maria Basin 34.5-36.0°	283	375	415	1001	515
Pt. Sur 36.0-36.5°	43	54	66	86	92
Monterey 36.5-36.83°	46	43	27	28	47
Half Moon Bay 36.83-37.66°	439	352	152	157	138
Farallon Is. 37.66-38.0°	254	114	23	11	25

Dover sole catch rates (Table 2) were similar to a trend in bottom area. In the Half Moon Bay region there is a large amount of bottom area shallower than 300m (Table 1). Dover sole seem to utilize this habitat as indicated by their greater density in shallow water off Half Moon Bay relative to their low density on the narrower shelf in the Santa Maria Basin.

Table 2. Dover sole catch rate in January-February 1987 trawl survey.

Depth (m):	183	366	550	730	915	1100-1281
	Catch rate (kg/hour)					
Santa Maria	1	43	29	133	248	5
Half Moon Bay	79	146	162	119	598	55

(R. Methot, FTS 893-7117)

COASTAL EASTERN PACIFIC POPULATION BIOLOGY OF FISHES

Habitat and Local Abundance of Juvenile White Seabass Identified

Biological Technician Sharon Kramer collected juvenile white seabass (mean length 24 mm) during routine monthly surveys for California halibut in shallow water coastal habitats between Mission Bay and San Onofre. The monthly surveys began in October

1986 and will continue to October 1988. Previous to this work, the juvenile habitat of this highly prized commercial and recreational species was unknown.

Surveys are conducted using a 1.6 m beam trawl. Four coastal sampling blocks are occupied each month and 12 trawls taken within each block (four random samples within each of three depth strata). In addition to sampling along the coast, Mission Bay and Agua Hedionda Lagoon are also sampled.

Nearly all of the juvenile white seabass were taken in shallow water of 7 m or less in depth along the open coast (none were taken at coastal depth strata of 11 m and 14 m). A few individuals were also taken in Mission Bay; these may have been fish that escaped or were released from the white seabass culture systems of SDSU/Hubbs Marine Research Center, however.

Kramer's data indicate that white seabass juveniles, after settlement from the planktonic larval stage, may prefer the very shallow sandy coastal areas near the first breaker line. These areas characteristically contain substantial quantities of decomposing drift algae and high standing stocks of potential forage (crustacia) for juveniles.

Maximum abundance of juveniles occurred in July. Laboratory rearing indicates fish of 23 mm are about 2 months old, indicating a peak spawning may have occurred in May or June.

In July, the mean density over the 40 nmi x 0.5 nmi coastal strip (6,880 hectares) included in this study was 4.68 juveniles/hectare. Thus, there may have been 32,000 juveniles inhabiting this narrow, 40 nmi long coastal band in July. Preservation of such shallow water habitats may be important for white seabass survival. (J. Hunter, FTS 893-7108)

FISHERY-MARINE MAMMAL INTERACTIONS DIVISION

La Jolla, California

FISHERY INDEPENDENT DATA PROGRAM

Second Annual Survey to Monitor Dolphin Abundance Launched

The second set of cruises to survey dolphin populations in the eastern tropical Pacific was launched as 12 observers, 2 research vessels, and a helicopter headed for the eastern tropical Pacific. The NOAA Ship *McArthur* left on July 30 and the *David Starr Jordan* left on August 8, 1987. The cruises are organized in four legs, with stops at Manzanillo, Mexico; Hilo, Hawaii; Lima, Peru; San Jose, Guatemala; and Rodman, Panama. Dr. Rennie Holt is the Chief Scientist for the cruises.

Front row, left to right: Izadore Barrett, Center Director; Scott Benson, Dolphin Observer; Scott Sinclair, ID Specialist; Hannah Bernard, Photogrammetrist; Carrie Fried, Dolphin Observer; Larry O'Brien, Bird Observer; Cindy Moore, Bird Observer; Keith Rittmaster, Dolphin Observer; Vickie Thayer, Oceanographer; Sallie Beavers, Dolphin Observer; Jim Caretta, Bird Observer; Aleta Hohn, Cruise Leader; Al Jackson, Cruise Leader, and Bob Pitman, ID Specialist. Back row, left to right: John Carr, Deputy Director, Joe Raffetto, Dolphin Observer; Jay Barlow, Cruise Leader; Ric LeDuc, ID Specialist; Bill Irwin, Dolphin Observer; Steve Reilly, Dolphin Environmentalist; Dave Skordal, Dolphin Observer; Rennie Holt, Chief Scientist; Wayne Perryman, Photogrammetrist; Liz Vetter, Cruise Leader; Pete Stangl, Cruise Coordinator; Marc Webber, ID Specialist; Mark Lowry, Photogrammetrist; Doug DeMaster, Cruise Leader; Carla Bisbee, Dolphin Observer.

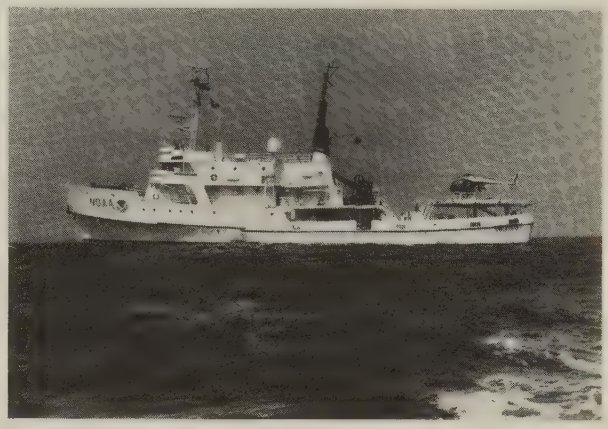
The overall objectives of the project are to determine the status of dolphins in the ETP and to assess the environment where the U.S. tuna fleet captures these dolphins for the tuna associated with them. The program was begun as a result of an amendment in 1984 to the Marine Mammal Protection Act of 1972. After reviewing the Bill for reauthorization, Congress mandated the Fisheries Service to design and implement a program to monitor the relative abundance of dolphin stocks in the ETP.

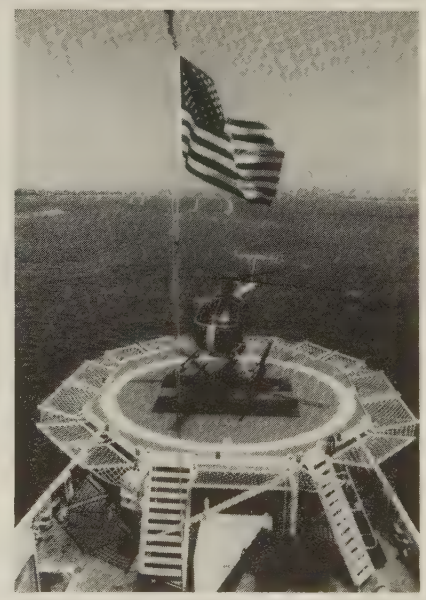
Similar to last year's cruise, a daily watch for marine mammals will be maintained during daylight hours on both vessels. Two teams of three observers each will rotate 2 hours on and off the 25 x 150 binoculars. When a marine mammal school is sighted, it will be tracked using a computerized tracking system (the CAST system) and then the school will be approached to obtain species identification and composition.

This year's cruise is very similar to last year's cruise in that the same vessels are being used and essentially the same area is being covered. The major difference in this year's cruise is the use of a helicopter aboard the *Jordan*. A helipad has been installed on the *Jordan* and a Hughes 550D helicopter will be used to photograph dolphin schools. A sophisticated camera system has been attached to the underside of the helicopter. After a marine mammal school is detected, the helicopter will hover over the school as photographs of the school are taken. The photographs will be used to calibrate the estimates of the observers from the ship.

NOAA Corps Officer LCDR. Wayne Perryman developed the camera system that is being used to photograph the dolphin schools. Photographing schools of dolphins at sea poses a special set of problems that most camera systems cannot accommodate. The animals are small, they occur in groups that may include from 50 to as many as 6,000 animals, the animals contrast only slightly with the environment, and resolution is lost by light passing through the water. The camera system incorporates low altitude reconnaissance cameras (developed by the U.S. Navy) that have fast lenses (large maximum aperture), with excellent optics, film transport that can cycle at up to six frames per second, and image-motion compensation that moves the film within the camera at the same speed that the image moves across the focal plane. The superb resolving power of these camera systems makes it possible to count the number of dolphins and determine the species of the dolphins from the photograph.

On this set of cruises, 37 scientific and technical personnel, representing several disciplines and agencies, will complete a wide variety of biological, oceanographic, and environmental research projects. In addition to the SWFC scientists, there are representatives from the Tropical Ocean and Global Atmosphere Program, Atlantic Oceanographic and Meterological Laboratory, Yale University, North Carolina State University, Southampton College, and NOAA Pacific Marine Center. Scientists will gather information on dolphins, whales, birds, turtles, flyingfish and other fish, and squid. As on last year's cruise, scientists will be collecting oceanographic measurements such as sea temperature, salinity and nutrients to obtain a clear profile of the type of habitat the dolphins prefer. (R. Holt, FTS 893-7098)





Top left: Camera system attached to the underside of the helicopter. Top right: *David Starr Jordan* with newly installed helicopter and helipad. Right: Helicopter landing on *Jordan* after trials at sea.

BIOLOGY PROGRAM

Re-examination of Early Data Prompts Discoveries of Stress Diseases in Dolphins

Based on blood chemistry values taken from live spotted dolphins captured during purse-seining operations in 1977 and 1978, Wildlife Biologist Dr. Al Myrick has concluded that blood

calcium levels of the sampled animals were abnormally low. Myrick reports that according to literature sources mammal serum calcium values usually lie between 9.0 and 12.0 mg/dl. Other data gathered by Dr. Ridgway of Naval Ocean Systems Center in San Diego, Dr. Daniel Odell of the University of Miami, and Dr. Warren Stuntz of the Southeast Fisheries Center in Pascagoula, Mississippi, show that the calcium levels in both wild and captive dolphins that are not under apparent stress fall well within the range known for other non-stressed mammals. However, blood calcium measurements of the purse-seined spotted dolphins ranged from 6.1 to 10.1 mg/dl, with an average value of 8.0 mg/dl.

When the possibility was excluded that most of the sampled tropical dolphins with hypocalcemia were diseased, Myrick searched the endocrinological literature further. He found that blood calcium depression is a common response in animals subjected to various forms of noxious stimuli. These stressors include extremes in temperature, starvation, forced physical exercise, and anxiety. An intense, prolonged, or repetitive stressor can cause adrenal secretion of steroids into the blood, the amount directly related to the strength and duration of the stimulus. And in sufficient concentrations, serum steroids can bring about severe hypocalcemia and produce various symptoms of tetany. In the more susceptible species, the steroid flood and resultant hypocalcemia can quickly cause death in many individuals.

Myrick compared symptoms of stress-induced hypocalcemia with symptoms in animals that are captured in the wild and animals that are transported from one location to another. He concluded that diseases under a multitude of names including "capture myopathy" and "shipping disease," for which the prescribed treatment is sodium bicarbonate and steroids, is actually produced by stress-induced hypocalcemia. If Myrick's anlysis is correct, then treatment should logically exclude steroids and include calcistatic hormones. Myrick is now in the process of preparing manuscripts on various aspects of this subject. Among the topics being considered is the problem of hypocalcemic behavioral symptoms and recovery times for chased and captured dolphins in the purse-seine fishery. (A. Myrick, FTS 893-7092)

FISHERY DEPENDENT DATA PROGRAM

Workshop Held on Tuna Purse-Seiner Fishing Effort: Observers' Perceptions

A workshop to aid in developing a computer simulation model of the tuna purse-seine fishery in the eastern tropical Pacific

Ocean fishery was conducted by Dr. Elizabeth Vetter, Research Biologist, at the Southwest Fisheries Center on 12 August. Workshop participants included 7 observers with combined experience of over 5 years at sea on tuna purse-seiners, Dr. Jacquie McGlade, a systems modeler from the Bedford Institute of Oceanography in Nova Scotia, and Dr. Pierre Kleiber, Research Biologist in the Pelagic Fisheries Resources Division, another modeler with extensive experience developing fishery models. McGlade and Kleiber will be participating with Vetter in model development and analysis.

The objective of the modeling program is to evaluate the utility of data collected by observers on tuna vessels for indexing trends in abundance of dolphin populations associated with the tuna stocks. The objective of the workshop was to learn from discussions with experienced observers their perceptions of the factors that affect fishing strategies and fleet movements of the purse-seine fishery.

The simulation model will allow researchers to investigate how dolphin sightings by observers on tuna boats may be affected by the distribution of fishing effort, the economics of the tuna business, and environmental conditions. A critical component of this model will be adequate representation of the "rule-set" (factors that control how tuna fishermen search for schools of tuna) followed by purse-seiners in their search for fishable schools of tuna. Two obvious sources of information about this "rule-set," and its effects on dolphin sightings, are the captains of the vessels and the observers.

The workshop was organized as the first step in developing as broad an understanding as possible of the searching process. The discussions with observers during the workshop were especially important in providing evidence for the importance of recent technological changes in the methods tuna purse-seiners use to find fish; most notably, the various ways that helicopters are used, the dynamics of sets of boats fishing in "code groups," (groups of skippers who share confidental information) and the recent addition of a third or fourth set of high-power binoculars to the searching process.

Following the workshop, using the information gained from workshop participants and advice from McGlade, Vetter prepared a draft version of a questionnaire to be used in interviews with all captains of tuna purse-seiners in the ETP willing to cooperate in the study. McGlade has had considerable experience developing a similar model for the North Sea groundfish fishery. She found during her study that interviews with skippers were critically important to model development and analysis.

The first interview, held on 14 August, was well received by the skipper interviewed. His cooperation provided much valuable information about factors controlling the fishing process, and in large part corroborated as well as extended the information provided by the observers at the workshop two days before. Subsequent interviews will be conducted throughout the fall, as model development proceeds. (L. Vetter, FTS 893-7099)

HONOLULU LABORATORY

Honolulu, Hawaii

Cooperative Research with NOAA-University Cooperative Institute Is Planned

Potential collaborative research between ocean scientists from the Honolulu Laboratory and the University of Hawaii was the topic of a July meeting with Dr. George W. Boehlert, Chief of Insular Resources Investigation; Dr. Jerry A. Wetherall, Chief of Pelagic Resources Investigation; and Dr. Dennis Moore, Director of the Joint Institute of Marine and Atmospheric Research (JIMAR). The institute was created in 1977 by an agreement between NOAA-Environmental Research Laboratories and the University of Hawaii. The major areas of research have been in climate, equatorial oceanography, and tsunami studies, with the Pacific Marine Environmental Laboratory in Seattle as the major NOAA component in cooperative research. Institutes such as this one have been established at several universities around the country to facilitate cooperative research between NOAA and academic scientists.

A new area of research--fisheries oceanography--was proposed by Boehlert, who provided documentation and made a presentation to the JIMAR Administrative Board in July. This area has been approved, and initial discussions on cooperative research are under way. Plans for the 1988 fiscal year will focus on the physical and biological oceanography of the North Pacific Transition Zone, where significant fisheries exist for squid and albacore. Other work is planned on the study of current flow around islands, particularly as it relates to retention and recruitment of pelagic larval stages.

The JIMAR expertise in acoustic Doppler current profilers (ADCP's) will significantly assist the Honolulu Laboratory: The NOAA Ship *Townsend Cromwell* has recently installed an ADCP, and measurements are currently under way on a *Cromwell* cruise at the Hancock Seamounts. (G. Boehlert (808) 943-1234)

INSULAR RESOURCES INVESTIGATION

Analysis Completed for Deepwater Artificial Reefs in Hawaii

Robert B. Moffitt, Fishery Biologist, and Frank A. Parrish, Research Assistant, recently completed an analysis of information obtained during 1-1/2 years of censusing fishes on Penguin Bank, Hawaii, where two types of artificial reef modules were set in deep water in October 1985. A single module of stacked fiberglass-reinforced plastic cylinders was set at 117 m, and four smaller stacked concrete conduit modules were placed at each

of two sites, one at 98 m and the other at 61 m. A visual census of fish community populations was conducted within 48 hours after setting, and approximately quarterly thereafter, using the submersible *Makalii*.

Moffitt and Parrish found that reef depth apparently was more important than structural material or design of the reefs in determining the aggregated biomass of transient species (e.g., *Seriola* sp., *Naso* sp., and *Pristipomoides* sp.). These species aggregated around the reefs very quickly. The community composition, diversity, and biomass of transient species were similar for the two deeper reefs, one concrete and the other plastic, despite differences in reef structural material, design, and volume (5.6 m^3 for the deep concrete reef and 139 m^3 for the fiberglass reinforced plastic reef). The observed biomass of transient species at the shallow reef was usually much less than at the deeper reefs (Fig. 1), with the exception of the February 1986 observation of a large school of Decapterus sp. passing through the area.

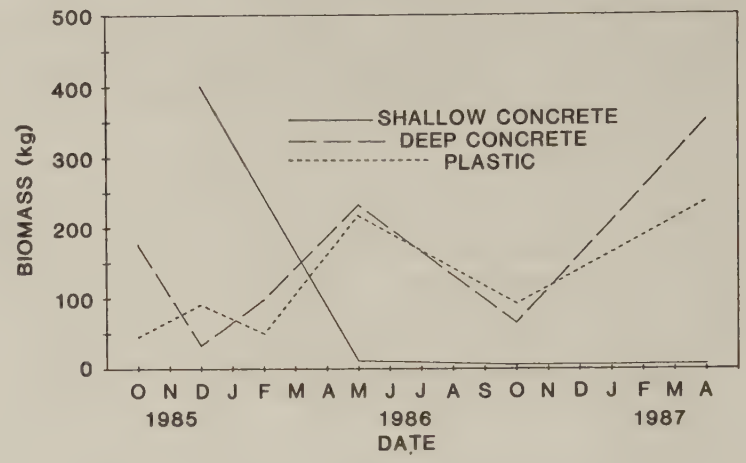


Figure 1. Biomass of transient species at Penguin Bank artificial reefs.

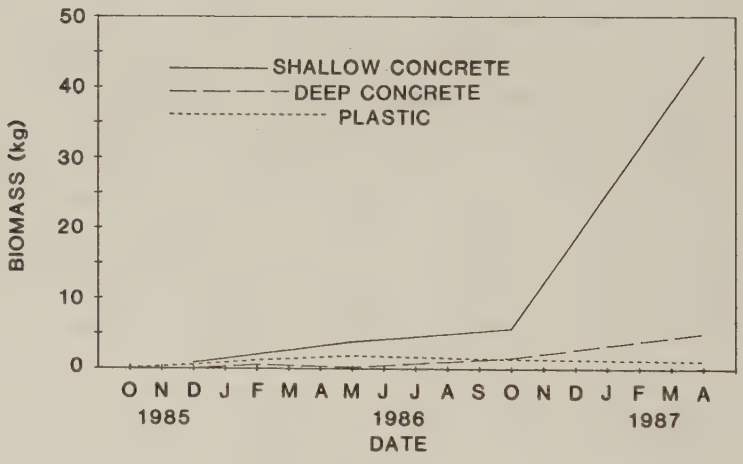


Figure 2. Biomass of reef resident species at Penguin Bank artificial reefs.

The diversity and richness of reef resident species (e.g. goatfish, butterflyfish, surgeonfish, and damselfish) started at zero and increased throughout the 18 months of the study at all reef sites, with greater rates of increase occurring at the shallow concrete reef. The biomass of the resident species, though increasing at all sites, was very small compared to that of transient species, generally less than 5 kg at any reef site during the last 6 months (Figs. 1 and 2). The biomass of reef resident species as a function of reef volume had mean values of 2.7, 0.27, and 0.009 kg/m^3 at the shallow and deep concrete reefs and the fiberglass-reinforced plastic reef, respectively.

Results of this study indicate that deepwater artificial reefs in Pacific island areas will work primarily as devices for aggregating fish rather than for increasing fish production and that reef volume and vertical relief are not very important in aggregating transient species. These results will be presented in November at the Fourth International Conference on Artificial Habitats for Fisheries. (J. Polovina (808) 943-1218)

PELAGIC RESOURCES INVESTIGATION

Analyses Completed on Albacore Otolith and Tagging Data

During August, Dr. Jerry Wetherall, Chief of the Pelagic Resources Investigation, and Marian Y. Y. Yong, Mathematician, completed a working paper on "Growth variation and stock structure in North Pacific albacore" for the 10th North Pacific Albacore Workshop held in Shimizu, Japan, during 11-13 August. The paper is co-authored with Dr. R. Michael Laurs and Robert Nishimoto of the Coastal Fisheries Resources Division in La Jolla.

The paper describes analyses of otolith daily increment counts and extensive tag return statistics to 1) estimate models of age and growth, 2) assess geographical differences in growth rate, and 3) elicit information on spawning seasons and birth-date distributions. The increment counts were made on lightly etched, whole otoliths. Otolith counts and data on tag releases and returns were carefully screened to remove outliers and unreliable observations.

Both otolith data (from 225 albacore) and tag return data (from 521 tag returns) suggested faster growth for albacore in an hypothesized "south" substock (generally supporting the United States fishery south of lat. 40°N and east of long. 135°W) than for those in a "north" substock (generally supporting the Japanese fisheries, and the United States fishery in the central Pacific Ocean and in the area north of lat. 40°N and east of long. 140°W). Otolith data, however, indicated much faster growth than is shown by the tag returns. Growth rates of tagged albacore, on the other hand, are generally consistent with historical length-frequency statistics and the assumed 1-year interval between adjacent length-frequency modes.

Daily increment formation has been validated for albacore larger than 51 cm fork length by tetracycline-tagging experiments, so the whole counts on otoliths were expected to provide accurate age estimates. However, for the whole otolith preparations, daily increments on older albacore may have been undercounted, especially those deposited during the first 2 years of life. As a result, ages may have been underestimated, and growth rates based on the otolith data overestimated.

Otolith increment counts for albacore younger than 1.5 years old were assumed to be unbiased; they were used to estimate mean fork length at first birthday. This result (35-38 cm fork length at 1 year) was combined with the tag return statistics to estimate growth models for the two groups of albacore.

Assuming these composite models are correct, spawning seasons for the south and north albacore are estimated to peak roughly 6 months apart, with north fish spawning primarily in the summer and south albacore in winter (with a fair amount of overlap).

These results hinge on several critical assumptions, which require further investigation. In particular, increment counts on whole otoliths should be compared with counts taken on other preparations (e.g., various types of sections). Variations in otolith microstructure should also be studied. Increment width patterns and other features may provide useful additional tests of stock structure hypotheses. (J. Wetherall (808) 943-1221)

Panel Discussion Focuses on Migratory Fish Management

Dr. Robert A. Skillman, Chief of the Pelagic FMP Research Program, participated on a panel, "Diverse viewpoints regarding migratory fish management," at the Hawaii Ocean Affairs Conference on 7 August 1987 at the East-West Center in Honolulu. Skillman presented the discussion "Biological overview of migratory, open ocean, pelagic fish." Beginning with a brief description of the taxonomic relationships of tunas, billfishes, and sharks, Skillman discussed the spawning areas and seasons of selected species. This information was then related to dispersal and migration as they affect fisheries and management. The panel was chaired by Craig Harrison, an attorney and formerly an avian biologist with the U.S. Fish and Wildlife Service in Honolulu. Other panel members included David Burney of the American Tuna Boat Association and Jon Van Dyke of the School of Law, University of Hawaii. (R. Skillman (808) 943-1257)

Research Cruise Planned for Pelagic Management Unit Species

The first research cruise to assess pelagic management unit species, primarily mahimahi and wahoo, since the inception of the program in January 1987 is scheduled to leave October 14, 1987. Preliminary cruise instructions have been completed.

The cruise, which will be conducted from the NOAA Ship *Townsend Cromwell* will concentrate on collecting larvae and juveniles of pelagic management unit species by neuston and subsurface sampling gear to support studies on recruitment and growth. Oceanographic data also will be collected for recruitment studies conducted from the *Townsend Cromwell*, as well

as for the tracking work of the research vessel *Kaahele'ale* performed in conjunction with the *Townsend Cromwell*. The primary candidate for tracking is the mahimahi. The assessment survey and tracking will occur off the Waianae coast of Oahu, in the area of the fish aggregating buoys R, S, and V, which are maintained by the State of Hawaii. (R. Skillman (808) 943-1257)

Spawning Behavior of Captive Mahimahi Examined

Thomas K. Kazama, Fishery Biologist, completed the second draft of the manuscript "Spawning behavior of the dolphin *Coryphaena hippurus* in captivity." Staff of the Honolulu Laboratory undertook the rearing of mahimahi to provide known age specimens for validation of otolith aging techniques, which, in turn, support analysis of growth and recruitment. Kazama's manuscript describes earlier research on the spawning and maintenance of adult mahimahi and rearing of larvae in tanks located at the Honolulu Laboratory's Kewalo Research Facility. Specifically, observations on spawning, behavior, and mortality are described. (T. Kazama (808) 943-1227)

Reports on Pelagic Management Unit Species Assigned

The Pelagic FMP Research program has been assigned the responsibility of preparing an annual report on pelagic management unit species (mahimahi, wahoo, billfishes, and sharks) and all computer programs necessary to complete this report. Subsequent reports are to be prepared by the Western Pacific Fishery Information Network (WPACFIN) task in the Fishery Management Research Program. Products from this project also will be used by the Western Pacific Regional Fishery Management Council's Pelagic Plan Monitoring Team to prepare its annual report.

Dr. Robert A. Skillman, Chief of the Pelagic FMP Research Program, has rewritten a dBASE computer program (originally written by Todd Kassman, a former WPACFIN Computer Programmer) to produce annual and monthly summaries of sales and revenue by fishing gear, for pelagic management unit species landed in American Samoa, Guam, and the Northern Mariana Islands. Summaries have been completed for 1982-85 (1985 data are incomplete) for American Samoa, 1979-87 (1987 data are incomplete) for Guam, and 1979-84 for the Northern Mariana Islands. More recent data for American Samoa and the Northern Mariana Islands are now being processed by WPACFIN to complete the time series. The next phase of the project is to prepare a computerized procedure for summarizing sales and revenue statistics for Hawaii. (R. Skillman (809) 943-1257)

American Samoa Field Station Reports Landings

Victor A. Honda, Research Assistant, and Gordon S. Yamasaki, Fishery Biologist, have completed a draft report on the NMFS purse seine sampling program in American Samoa. Their report summarizes a vast quantity of data collected from 1980 to 1986 from the U.S. purse seine fleet that off-loads in American Samoa.

In American Samoa, the number of purse seiners off-loading grew from 4 vessels (5 trips) in 1980 to 30 vessels (87 trips) in 1986. Total purse seine landings rose on an index basis from 100 in 1980 to 2,700 in 1986. The number of transshipment off-loadings declined from 55 trips in 1980 to 18 in 1986. The total transshipment landings (by weight), however, increased by 81% over the same period.

Skipjack tuna constituted 70% of landings, and the rest of the landings were yellowfin and bigeye tuna. Length-frequency data from more than 17,000 skipjack tuna, 11,000 yellowfin tuna, and 1,200 bigeye tuna were graphed on a quarterly basis for 1985.

Yamasaki, who is stationed in Pago Pago, collected the catch data with the assistance of the staff of the local Office of Marine Resources. The data were compiled by Honda, with the assistance of Dr. Jerry L. Fuqua, Computer Programmer, in Honolulu. The report is being edited and will be released as a Southwest Fisheries Center Administrative Report. (S. Pooley (808) 943-1221)

Mid-Year Data on Tuna and Lobster Are Available

Mid-year data are now available for two of the fisheries monitored by the Honolulu Laboratory--tuna and lobster.

In American Samoa, 109 foreign longline fishing vessels off-loaded during the first 6 months of 1987, according to Fishery Biologist Gordon Yamasaki. Some landings were for the two canneries in American Samoa; some were transshipped to Japan as sashimi grade tuna. There were 59 purse seine landings during the same period.

In the Northwestern Hawaiian Islands, total revenue of the lobster fishery was about $900,000 for the first 6 months of 1987, according to Raymond P. Clarke, Research Assistant. Ex-vessel prices increased substantially, with spiny lobster tails averaging $12.52 per pound and slipper lobster tails averaging $9.11 per pound. During this period, lobster sales were 37.2 metric tons (82,000 pounds) of processed product from 94,214 legal spiny lobsters and from 140,586 retained slipper lobsters. Total fishing effort, as well as catch and revenue, substantially

declined in 1987 compared to the levels in 1986. (S. Pooley (808) 943-1216)

Unusual Lobsters Visit Honolulu

Several specimens of relatively rare lobsters were delivered recently to Honolulu, according to Research Assistant Raymond P. Clarke. These lobsters were caught during normal trapping operations in the lower portion of the Northwestern Hawaiian Islands.

The fishing vessel *Bounty* landed three specimens each of the western lobster, *Enoplometopus occidentalis*, and long-handed spiny lobster, *Justitia longimana*. The long-handed spiny lobster's claws have splotches of rich crimson, similar to that of the American lobster. The *Bounty* later brought in four specimens of the shovel-nosed lobster, tentatively identified as *Scyllarus timidus*.

The fishing vessel *Archer* caught another specimen of the long-handed spiny lobster, which was kept alive and turned over to Sea Life Park for use in its reef tank. (R. Clarke (808) 943-1213)

WPACFIN Program Manager Completes Rotational Assignment

David C. Hamm, Program Manager of the Western Pacific Fishery Information Network (WPACFIN), recently spent 2 months at the NMFS headquarters in Washington, D.C., on a special rotational assignment. Hamm was 1 of 10 NMFS employees selected to participate in this special program designed to provide additional opportunities to broaden the scope and experience of promising management candidates.

Assigned to the Data Management Division, Hamm worked on Information Technology 1995 (IT-95), which is a major NMFS-wide project designed to modernize and unify NMFS's computer capabilities. Visiting each Center and meeting with scientists and data processors enabled Hamm to help identify the needs of computer users and translate them into a more comprehensive description of the many IT-95 components, such as major processing needs, a wide area network, local area networks, office automation, word processing, and graphics capabilities. He then categorized each component by the agency responsible for its funding and implementation.

Even though Hamm's involvement in IT-95 at the NMFS headquarters level was short compared to the duration of the project, its leaders all believe that his field perspective and insight greatly benefited the project. According to Hamm, the

rotational assignment was a positive experience--both professionally and personally. He highly recommends participation in the program to all qualified NMFS employees.

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Monterey, California

Jack Mackerel Ages Compiled

Janet Mason, Fishery Biologist, is nearing completion of a technical report on the age composition of jack mackerel, *Trachurus symmetricus*, landed in southern California from 1972 to 1983. The purse seine fishery in southern California harvests schools of pelagic fish in local waters. Schools of jack mackerel, Pacific mackerel, and sardine are often found mixed together. The jack mackerel caught this way are primarily small, young fish which are sold to the canneries. This is the only fishery targeting on jack mackerel. Larger fish are taken farther offshore as incidental catches of other fisheries; mackerel caught in those fisheries are not included in this report.

Although commercial landings of jack mackerel from the southern California purse seine fishery have been sampled by the California Department of Fish and Game for many years, age frequency information was not available for the 1972-73 through 1983-84 seasons because the otoliths had not been read. NMFS established a contract with experienced otolith readers to determine the ages for these fish, so age composition tables for these years could be produced. This completes the time series of data for 1947 through 1983.

Because the purse seine fishery harvests mixed schools of mackerel, the weight of each species must be estimated from its relative abundance in the catch. This has been done by the California Department of Fish and Game wardens who sample the boatloads of mackerel as they are unloaded and determine the percent of each species present by weight. The monthly jack mackerel landings are proportional to the weight of jack mackerel present in the total weight of boatloads of mackerel sampled that month.

Total southern California jack mackerel landings by year class (Figure 1) show highly successful year classes in 1952, 1958, and 1974. 1980 appears to be another good year even

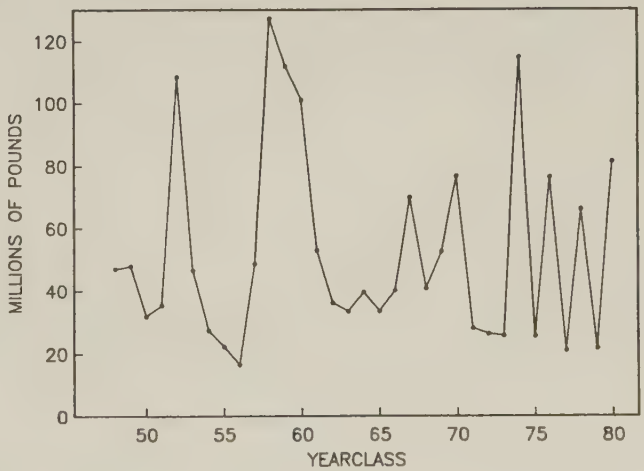


Figure 1. Total southern California landings of jack mackerel by year class. Includes 1947 to 1983 landings of 1947 to 1980 year classes.

before all ages are caught. Note the alternation of good and poor year classes from 1974 through 1980. Plans are being made to investigate this phenomenon.

Fish older than age 2 contributed significantly to the catch in years prior to 1965 (Figure 2). However, since 1965, their contribution to the purse seine catch has been very small. This could be due to changes in gear or fishing areas in the mid-60's; these and other possible causes will be explored in the future. (J. Mason (408) 646-3311)

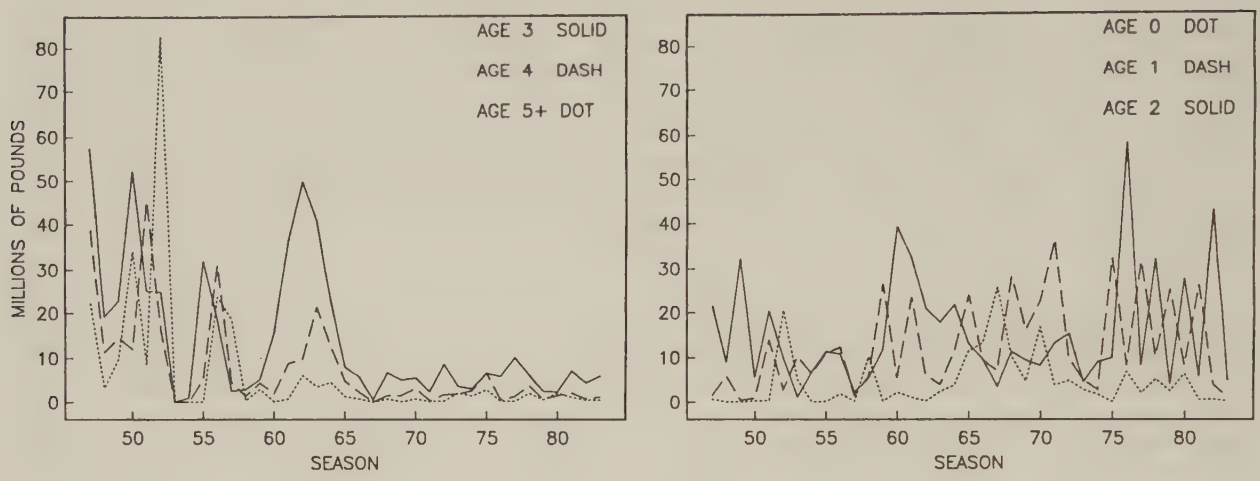


Figure 2. Southern California landings of jack mackerel by fishing season showing each age group.

PELAGIC FISHERY RESOURCES DIVISION

La Jolla, California

STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

Billfish Behavior and Interaction Studies Resume

The cooperative research investigating the behavior of swordfish and striped marlin which is being conducted by staff of the Pelagic Fisheries Resource Division and staff of the California Department of Fish and Game will begin its second year of work in August. The research is designed to identify similarities and differences in the diel behavior of the two species and to assess their vulnerability to various forms of fishing gear.

For this year, seven trips are planned, each lasting 5 days, to tag and track swordfish and striped marlin. Tagging and tracking equipment has been upgraded this year to allow direct input of time/depth data into an onboard portable computer, which will allow faster analysis of data. The program has been expanded to include an observer from Instituto Nacional de la Pesca, La Paz, Mexico, who will be joining the research team this year.

During the fall of 1986, Fishery Biologists David Holts and Earl Weber and CDFG Biologist Dennis Bedford conducted six, one-week tagging and observation trips in the Los Angeles Bight. They successfully tracked two striped marlin and one swordfish. Based on their studies, they found that striped marlin remain in the upper 10 m of water most of the time, whereas swordfish maintain a depth of 20 to 40 m during the night and make deep dives to at least 300 m at sunrise and again at sunset. Biologists speculate that swordfish feed at or near the bottom during these dives and marlin feed on small pelagic prey that are near the surface. (D. Holts, FTS 893-7186)

Boat Captains Presented Awards for Tagging Billfish

The Gardiner Foundation of Oakland, California, sponsors an award program for sportfish boat captains in the Baja California Sur, Mexico area who tag the most billfish in a year. Records of tagging are taken from the billfish tagging program, which is sponsored by the Southwest Fisheries Center and directed by Fishery Biologist James Squire. Winners are determined, and Squire presents the awards on behalf of the Gardiner Foundation. Awards consist of plaques and cash awards.

The award ceremony was held at Rancho Buena Vista, located on the east cape of the Baja California peninsula; anglers and representatives of the local community attended the

presentations. The 1987 winners were Captain Jesus Araiza (1st place) with 86 fish tagged, Captain Victor Garciglia (2nd) with 57 fish tagged, Captain Gilberto Castro (3rd), Captain Manuel Castro (4th), Captain Martin Fiol (5th), and Captain Eduardo Cassio (6th). During the 1986 fishing season, 43 captains participated in the tagging program and tagged a total of 437 billfish. (J. Squire, Jr., FTS 893-7072)

TIBURON LABORATORY

Tiburon, California

GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATION

Lipid Profiles of Female Yellowtail Rockfish During the Summer of 1987 Studied

Since April 1985, Oceanographer R. Bruce MacFarlane has been measuring nutritional dynamics in reproductive success of mature female yellowtail rockfish. During this period, monthly measurements have been made of serum compounds (e.g., glucose, protein, free amino acids, and lipid components) required for maintenance, growth, activity, and reproduction. These data and data generated by other members of the Groundfish Physiological Ecology Investigation to assess physiological and reproductive status of individuals indicate that lipids appear to be of primary importance for reproductive development.

Data collected between April 1985 and April 1986 revealed a pattern of lipid accumulation and mobilization that is relatively consistent from 1985 to 1986. After parturition, serum lipids, mesenteric fat, and liver size were at their annual minima. This occurred in April of both years and reflects depletion due to reproduction and low food abundance.

During the summer months, primarily June and July, mesenteric fat, liver size, and serum triglyceride, cholesterol, and phospholipid attained high values due to intensive feeding. Just before hepatic vitellogenesis and gonadal development, mesenteric fat and liver size declined, and serum lipid concentrations decreased only slightly.

During the period of gonadal development (increasing gonadosomatic index, or GSI), there were again increasing lipid concentrations in the liver, mesentery, and serum which reached maxima one to two months before the maximum GSI. This was followed by a gradual decline in lipid levels in all compartments to the postparturition state.

Unfortunately, during this study period MacFarlane was unable to analyze muscle and ovary for lipid; therefore, the contributions of these tissues to lipid mobilization and metabolism are incomplete. However, it is probable that muscle lipids follow a pattern similar to that of the mesentery and liver size (which changes annually largely in response to lipid accumulation and depletion), and ovary lipid levels probably parallel the GSI. Changes in lipid distribution in liver, muscle, and gonad tissues will be resolved by Biological Technician Beth Norton during the current reproductive year (initiated in May 1987)

A preliminary inspection of the data, generated from May to August of this year, shows a pattern of lipid accumulation and mobilization that is generally similar to the pattern in the past 2 years, but with a few notable differences. Mesenteric fat and liver size show a progressive increase through August, unlike peak values observed in June or July in previous years. Also, the mean mesenteric fat in August (1.6% of the total body weight) is the highest value recorded during this study. Liver lipid concentrations increased sharply from May to June, whereas lipid showed only a slight increase in muscle and remained essentially unchanged in ovary. Serum lipids have steadily increased from March to August, with the exception of triglyceride which peaked in June and has subsequently declined. However, this decline in triglyceride decreased the concentration to a mean value of 480 mg/dl in August, which is the maximum value recorded last summer (in July). Mean serum cholesterol in August was 345 mg/dl, the highest value found during this study.

Based on the data obtained since May, it would appear that female yellowtail rockfish have accumulated more lipid this summer than in the past 2 years. If lipid reserves are indeed an important determinant of reproductive success, the potential exists for this year's reproductive output to exceed those of the last 2 years. (R. B. MacFarlane, FTS 556-0565)

GROUNDFISH COMMUNITIES INVESTIGATION

Opposing Patterns of Spatial and Seasonal Abundance in Anchovies and Juvenile Rockfishes Related to Reproduction

In attempting to locate and identify major forage species of coastal predatory fishes, Fishery Biologist Peter Adams and Biological Aid Wayne Samiere found that anchovies (*Engraulis mordax*) and juvenile rockfishes (*Sebastes* spp.) in the Gulf of the Farallones have opposite patterns of spatial and seasonal abundance

Adams and Samiere made replicate collections with a midwater trawl at six stations in the Gulf of the Farallones--three onshore and three offshore--during eight cruises (two in April, four in June, and two in September) from 1983 to 1986.

The anchovy collections were larger in September than the collections in April or June, when the catches were similar. Most of the anchovies--which accounted for 95% of the fish collected--were taken from the onshore stations. The anchovies collected onshore also tended to be smaller than those from offshore, with the smallest fish consistently taken at the shallowest station, which was near the mouth of San Francisco Bay.

The pattern was just the opposite in the juvenile rockfishes. These were most abundant in the June collections, with few taken in April and none in September. Most were taken from the offshore stations. Juvenile rockfishes occurred in the onshore collections only in 1985, which was an unusually strong year for them. The species composition of the juvenile rockfishes differed between May and June. The three most abundant species in May were the chilipepper (*S. goodei*), shortbelly rockfish (*S. jordani*), and brown rockfish (*S. auriculatus*), whereas in June the shortbelly rockfish dominated, with the widow rockfish (*S. entomelas*) and blue rockfish (*S. mystinus*) being the next abundant.

These patterns appear to be related to reproduction and they appear to be mechanisms that place larvae and juveniles in favorable areas for survival and growth. Anchovies are probably migrating into San Francisco Bay from the Gulf of the Farallones during the April-June period. They are most abundant in the Bay during this period, and their eggs appear in the water column in greatest numbers in June and August. The Bay provides warmer water temperatures and more favorable first feeding conditions for the larval anchovies. The juvenile rockfishes are up in the water column for only a short period before descending to the deeper adult habitats. Their occurrence in the Gulf of the Farallones during this period places them in an area of recently upwelled water with high concentrations of food during the juvenile period of rapid growth. (Peter B. Adams, FTS 556-0568)

FISHERIES INFORMATION SYSTEMS & ADP

Data Acquisition System Readied for Dolphin Survey

Computer Systems Programmer Susan Jacobson fine-tuned the shipboard continuous data acquisition system in preparation for the departure of the NOAA Ship *David Starr Jordan's* cruise to the eastern tropical Pacific in early August. The data collection system records oceanographic information such as salinity and temperature and it is currently operating on a 24-hour basis. Jacobson conducted training sessions aboard the ship on the computer system and the operations of the data acquisition system for some of the ship's crew, technical staff, and for the cruise leaders on rotational assignment. She developed, drafted, and distributed the system and users' manuals to the cruise participants.

According to a progress report in late August from the *Jordan*, the system had switched to the stable voltage regulator because the uninterruptible power supply, the backup power system, had burned out. All other reports on the system, however, have been positive. (S. Jacobson, FTS 893-7060)

Responsibility for PacFIN Data Base Turned Over to SW Region

Responsibility for the continuation of the PacFIN research data base and generation of reports from the data base has been turned over to Charles Korson of the Southwest Region. The PacFIN research database is an historical and comprehensive data base of vessel and landing information for commercial vessels landing in California, Oregon, and Washington. The data base is used to track the activities and economic status of specified fishing fleets.

Until this year, it was compiled and maintained at the Southwest Fisheries Center for over 5 years, with Computer Systems Programmer Susan Jacobson as the lead programmer. Over the past year, Jacobson has been working with Korson to familiarize him with the procedures and methodology. With the completion of the addition of 1985 data to the data base, Jacobson will no longer be working on the data base. (S. Jacobson, FTS 893-7060)

STATUS OF PUBLICATIONS

Published

Balazs, George W. (compiler). 1987. Annotated list of shark attacks in the Hawaiian Islands--July 1987. Hawaii Fishing News 12(8):12-13.

Boehlert, G. W. 1987. Vzaimodeystvie techeniya i rel'eta v rayone sredinno-okeanicheskikh podvodnykh gor i ego vliyanie na pelagichie ekosistemy. s. 178-179 v:V.I. Ilyichev. Redaktor, Tikhookeanskiy Exhegodnik 1987 Vladivostok: Dal'nevostochnoe Otdelenie An SSSR. 196 s. [Abstract, in Russian.]

Echeverria, Tina Wyllie. 1987. Relationship of otolith length to total length in rockfishes from northern and central California. Fish. Bull., U.S. 85(2):383-387.

Echeverria, Tina Wyllie. 1987. Thirty-four species of California rockfishes: Maturity and seasonality of reproduction. Fish. Bull., U.S. 85(2):229-250.

The viviparous rockfishes (*Sebastes* spp.) differ among species in age and size at maturity, and in the timing of peak spermatogenesis, fertilization, and larval extrusion. Age at 50% maturity ranges from 2 years in *S. jordani* to 9 years in *S. diploproa*. Within species, males usually mature either at the same age and size as females or at a younger age and smaller size. Rockfishes have two major seasons of larval extrusion, winter (November-March) or spring (April-July). The reproductive season for a particular species will fall within one of the major seasons throughout its geographic range. Within the major season, annual variations in the peak month of larval extrusion was observed for individual species. A long reproductive season and variations in the annual timing of that season are evidence of plasticity in the reproductive biology of rockfishes.

Reproductive development at the cellular level was compared with the coincident changes in the gross morphology of the gonads. The resulting description of the developmental sequences of the testes and ovaries enables the determination of maturity stage in the field.

Herrick, Samuel F., Jr. and Steven J. Koplin. 1986. U.S. tuna trade summary, 1984. Mar. Fish. Rev. 48(3):28-37.

Moffitt, Robert B. and Jeffrey J. Polovina. 1987. Distribution and yield of the deepwater shrimp *Heterocarpus* resource in the Marianas. Fish. Bull., U.S. 85:339-349.

A shrimp trapping survey was conducted at 22 islands and banks in the Mariana Archipelago during a 2-year field period. Three species of deepwater shrimp were found in abundance at various depths: *Heterocarpus ensifer* at 366-550 m, *H. laevigatus* at 550-915 m, *H. longirostris* >915 m. *Heterocarpus laevigatus* was the largest and most abundant of the three and has the greatest economic potential. Estimates of the unexploited biomass of this species by bank were calculated from estimates of catchability, relative abundance, and habitat area. An archipelago average of the unexploited trappable biomass was estimated to be 0.8 t/nmi^2. Evaluation of length-frequency distributions produced estimates of asymptotic length (L_{∞}) of 55 mm carapace length, instantaneous growth constant (K) of 0.3 yr^{-1}, and instantaneous total mortality (Z) of 0.75 yr^{-1}. A recommended yield of 162.0 t/year (0.2 t/nmi^2 per year) for the entire archipelago was calculated using the Beverton and Holt yield-per-recruit yield, 85% would come from the southern islands (e.g., Guam and Saipan), 13% from the northern islands (e.g., Pagan and Anatahan), and 2% from the western seamounts (e.g., Arakane Reef and Pathfinder Reef).

Squires, D. 1987. Public regulation and the structure of production in multiproduct industries: An application to the New England otter trawl fleet. Rand Journal of Economics 18(2):232-247.

Squires, D. 1987. Fishing effort: Its testing, specification, and internal structure in fisheries economics and management. Journal of Environmental Economics and Management 14(3):268-282.

Wahlen, Bruce E., Ruth B. Miller, and Carolyn J. Macky. 1987. Composition of the incidental kill of small cetaceans in the US purse-seine fishery for tuna in the eastern tropical Pacific during 1985. Rep. Int. Whal. Commn 37:353-355.

Composition of incidental kill of small cetaceans by US registered purse-seiners fishing in the eastern tropical Pacific during 1985 is reported by area, species, stock, sex, length and reproductive condition. The data were collected by technicians of the Inter-American Tropical Tuna Commission and of the National Marine Fisheries Service during 53 vessel-trips.

Approved by Center Director

Ambrose, David A., Richard L. Charter, H. Geoffrey Moser, and Celeste R. Santos Methot. Ichthyoplankton and station data for California Cooperative Oceanic Fisheries Investigations survey cruises in 1951. For publication as NOAA-TM-NMFS-SWFC-79, 14 p.

Boehlert, George W. Fishing in the EEZ: the potential for island-related resources. [Abstract] For publication in the Proceedings of the Pacific Basin Development Conference.

Butler, John L. Interaction of larval sardine mortality rates and anchovy abundance. For consideration for publication in Fishery Bulletin, U.S.

Butler, John L. and Darlene Pickett. Age-specific vulnerability of Pacific sardine, *Sardinops sagax*, larvae to predation by northern anchovy, *Engraulis mordax*. For consideration for publication in Fishery Bulletin, U.S.

Holts, David B. Review of U.S. west coast commercial shark fisheries. For consideration for publication in Marine Fisheries Review.

Lamadrid-Rose, Yara and George W. Boehlert. Effects of cold shock on egg, larval, and juvenile stages of ocean thermal energy conversion. For consideration for publication in Marine Environmental Research.

Miyazaki, Nobuyuki and William F. Perrin. Rough-toothed dolphin *Steno bredanensis* (Lesson, 1828). For publication in the Handbook of Marine Mammals.

Perrin, William F. and James G. Mead. Clymene dolphin *Stenella clymene* (Gray, 1846). For publication in the Handbook of Marine Mammals.

Perrin, William F. and James W. Gilpatrick, Jr. Spinner dolphin *Stenella longirostris* (Gray, 1828). For publication in the Handbook of Marine Mammals.

Perrin, William F. and David K. Caldwell and Melba C. Caldwell. Atlantic spotted dolphin *Stenella frontalis* (G. Cuvier, 1829). For publication in the Handbook of Marine Mammals.

Polovina, Jeffrey J. and Ichiro Sakai. Artificial reefs can increase fishery production. For consideration for publication in Science.

Shomura, Richard S. Migration and movement patterns of tunas. [Abstract] For publication in the Proceedings of the Pacific Basin Development Conference.

Uchiyama, James H. and Jeffrey D. Sampaga. Age and growth of the pelagic armorhead, *Pseudopentaceros wheeleri*, at Hancock Seamounts. For consideration for publication in Fish. Bull., U.S.

Administrative Reports

Banish, Linda D. and William G. Gilmartin. 1987. Preliminary investigation: Hematology and serum chemistry of the young Hawaiian monk seal, *Monachus schauinslandi*. SWFC Admin. Rep. H-87-13, 10 p.

MacCall, Alec and Michael Prager. 1987. Historical abundance indexes for six fish species off southern California, based on CalCOFI larva samples. SWFC Admin. Rep. LJ-87-18, 45 p.

MacCall, Alec and M. Prager. 1987. Summaries of CalCOFI larva data and historical abundance indexes. SWFC Admin. Rep. LJ-87-20 (floppy disk only).

Oliver, Charles W. and Terry D. Jackson. 1987. Occurrence and distribution of marine mammals at sea from aerial surveys conducted along the U.S. west coast between December 15, 1980 and December 17, 1985. SWFC Admin. Rep. LJ-87-19, 15 p.

Thomson, Cynthia and Charles Korson. 1987. A report on the PACFIN research data base for 1985. SWFC Admin. Rep. LJ-87-21, 16 p.

Translations

Belyaev, V. A. 1985. Distribution of larvae and determination of abundance of year classes of common mackerel, *Scomber japonicus* Houttuyn (Scombridae) in the northwestern Pacific. Bull. Tohoku Reg. Fish. Res. Lab. 47:93-98. (Engl. transl. from the Japanese by W. G. Van Campen, 1987, 10 p., Transl. No. 113; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396.)

Darnitsky, V. B., V. L. Boldyrev, and A. F. Volkov. 1984. Environmental conditions and some ecological characteristics of fishes from the central North Pacific seamounts. In: P. A. Moiseev (editor), Proceedings, Conditions of Formation of Commercial Fish Concentrations, p. 64-77. Ministry of Fisheries of the U.S.S.R. All-Union Research Institute of Marine Fisheries and Oceanography VNIRO. (Engl. transl. by W. G. Van Campen, 1987, 12 p., Transl. No. 114; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396.)

Borets, L. A. 1977. Dynamics of size-age composition of catches of the boarfish, *Pentaceros richardsoni* (Smith). Investigation of the Pacific Ocean Scientific Research Institute for Fisheries and Oceanography (TINRO). (Izvestiya Tikhookeanskogo Nauchno-Issledovatel;skogo Instituta Rybnogo Khozyaistva i Okeanografii.) 8:65-69.

(Engl. transl. by W. G. Van Campen, 1987, 6 p., Transl. No. 115; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396.)

Suzuki, T. 1985. Food qualities of the tuna (Shokubutsu To Shite No Sakana...Maguro-Katsuo Wo Chusin Ni). Report of the Fiscal Year 1984 Japan Tuna Fishery Research Conference (Maguro Gyogyo Kenkyu Kyogikai Hokokusho). A special report. Japan Fisheries Agency, Far Seas Fisheries Reserach Laboratory, p. 1-7. (Engl. transl. by T. Otsu, 1987, 13 p., Transl. No. 116; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396.)

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